The Beaver Lake Monitor

A publication of the Beaver Lake Management District Advisory Board

www.sammamish.us • Volume 14, Issue 2 • December 2013

Part 9 of the Series:
Living with Your Wildlife Neighbors – Frogs

Some of Beaver Lake's animal residents are more likely to be heard than seen. You may love it or loathe it, but a chorus of croaking in the night is an important indicator of healthy habitat in the Beaver Lake watershed. Frogs are integral members of an aquatic ecosystem, and unfortunately their numbers are in decline, not just near Beaver Lake, but worldwide.

Frogs are extremely sensitive to environmental changes and unfavorable living conditions, and are considered important biological indicators as they can be used to monitor the state of an ecosystem. Frogs form an important component of the food chain, and are consumed by beavers, fish, owls, snakes, and other local wildlife. In addition, frogs make excellent insect hunters and provide natural pest control with their voracious appetites for eating spiders, ants, beetles, and flies.

Frogs and many other amphibious species are facing many threats in today's world, and numerous species are in severe decline, with many already extinct. Habitat elimination due to residential and commercial development, road construction, and recreation is perhaps the greatest threat to frogs. Frogs and other amphibians are also extremely susceptible to chytridiomycosis, a potentially lethal skin disease caused by the chytrid fungus, which is carried in water and soil and prevalent worldwide. Other threats to frog populations include warming climate, invasive species predation and competition, and overharvesting for food and the pet trade. Two species of frogs listed as endangered in Washington State are the Oregon Spotted Frog and the Northern Leopard Frog, and the Cascade Spotted Frog is listed as a species of concern. Luckily, there are still frogs living in the Beaver Lake watershed, and there are a few things you can do to ensure their survival.

The species of frog you are most likely to find (and hear) around Beaver Lake is the Pacific Tree Frog, or Chorus Frog. These frogs can be green, tan, or grey with a black mask reaching from the snout to the shoulder. Their skin changes color in response to background brightness, which can take anywhere from weeks to under ten minutes. They may grow up to 3 ¼" long, and females are typically larger than males. Circular pads on the tips of their toes suction to smooth surfaces and allow the frogs to climb to high places, though they spend most of their time closer to the ground. Pacific tree frogs spend their lives both near and away from water. For most of the year they can be found residing in forest shelters such as under rocks, logs, and leaf debris until breeding season, when they will migrate to ponds, wetlands, and slow moving streams. Breeding season is typically from February to July, and during this time the frogs are at their loudest, as the males begin "chorusing" in order to attract females. The "ribbit" and "kre-ek" sounds made by Pacific Tree frogs are produced in a resonating throat sack and can be heard for great distances.

If you are lucky, you may come across the Northern Red-Legged frog. This frog is considered a species of concern in British Columbia and has been identified in the Beaver Lake watershed. These frogs are black-speckled olive, brown, or tan with the underside of the body and legs a dark- to orange-red. Like the Pacific Tree Frog, red-legged frogs may reside away from water bodies in damp shelters.

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Construction at Trossachs 16 now in process

By Evan Maxim, City of Sammamish

The Trossachs Group is in the process of developing a new division of Trossachs, referred to as Division 16, to the east of the large bog wetland at the north end of Beaver Lake. Division 16 is the second to last phase of the Trossachs development; 28 homes are expected to be constructed in the spring and summer of 2014.

During construction of Trossachs Division 16, to assist in monitoring water quality within the bog, the city has required that the developer monitor the quality of water leaving the construction site at least three times per wet season (October 1 through April 30) until the last house is constructed.

Water quality data will be collected to evaluate changes in temperature, pH, alkalinity, dissolved oxygen, conductivity, nitrogen, phosphorus, and fecal coliform bacteria. Water quality samples were collected prior to the start of construction to establish a baseline condition for water discharging into the bog, as well as for water leaving the bog (downstream).

The city expects that the developer will be interested in development of Trossachs Division 17 in 2014 and 2015. Water quality monitoring for this phase of the construction will also be required until the completion of the 23 homes proposed in this division. The city has required that the drainage facilities be located and will discharge more than 215 feet from the edge of the bog wetland. As the developer begins to move forward with design of Division 17, additional information will be available for public review.

Trossachs 16 Development

Beaver Lake Fecal Coliform Monitoring

In 2005 the Beaver Lake Management District contracted with King County Lakes and Streams Monitoring (KCLSM, formerly the KC Lake Stewardship Program) to monitor the FC (FC) bacterium Escherichia coli (E-coli), in Beaver Lake. This year marked the ninth year of the project. FC abundance can be used as an indicator of potentially harmful pathogens present in water that are associated with human illness.

There are several standards in effect in Washington State. The Washington Department of Ecology has set water quality standards based on the number of colony forming units per 100 milliliters of water (cfu/100mls). For lakes, average FC concentrations must be less than a geometric mean (geomean) of 50 cfu/100mls, with no more than 10% of the samples exceeding 100 cfu/100mls in a sample location. The geomean is used because of the great variability of bacteria samples in water, and the effect of one high result to influence average values.

King County and the BLMD decided to use the Coliscan EZ Gel method (measuring E-coli rather than all FC species) because of the low cost of gathering and processing samples, while still providing relevant data. E-coli is a large group of bacteria with many strains that are harmless, as well as some that can be pathogenic to humans; it is often a good indicator of potential contamination in the lake.

Beaver Lake has several possible sources of FC bacteria. Domesticated animal waste not properly disposed of can be a significant contributor to FC bacteria, as can wild mammals

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Top 10 DOs & DØN'Ts for Beaver Lake Residents

Do

1. Practice natural yard care, building healthy soil in order to sustain your plants without pesticides, extra fertilizer, or frequent watering.
2. Communicate with your elected officials, city staff, or King County staff when you notice something unusual happening at the lake. They appreciate your sharp eyes, and you may bring something very important to their attention.
3. Plan your landscape to slow down stormwater before it leaves your property, no matter where you live in the watershed. Rain that percolates into the ground or moves slowly will not cause erosion problems, and this will decrease the amount of pollution reaching the lake.
4. Learn to identify the non-native weeds that grow in and around the lake. Many of them have very limited value for the native wildlife and can spread rapidly, outcompeting valuable native plants, if not controlled as soon as they appear.
5. Clean up pet waste and put it in the trash before it can be washed into the lake or stormwater system. Pet poo will increase bacterial concentrations in surface water and contains a lot of phosphorus and nitrogen.

Don't

1. Never throw anything into the lake, including plant material such as grass clippings, fallen leaves, or other yard waste. These decompose and add to the nutrients available for algae growth, which leads to decreased water quality.
2. Please don't feed the ducks or raccoons! They are cute, but it's healthier for them to find their own food and become self-reliant. Human foods are often not very nutritious for them and can cause health problems in the long run. And if they produce fecal waste near the lake, it's just as much of a problem as that of pets.
3. Never dump aquarium contents into the lake or inlet streams. Many infestations get started by folks who don't stop to think when they empty an aquarium into nearest water body… they are actually causing big problems for the animals and plants living naturally in the lake.
4. Don't wash your car with soap in your driveway or use toxic materials to refinish decks, docks, or outdoor furniture.
5. Don't remove all of the native shrubs, sedges, and other plants that grow by the edge of the water. These plants can intercept some nutrients before they get into the lake water and also provide important habitat for threatened species, such as frogs. Natural growth overhanging the water also provides food for fish when insects fall from the branches into the lake.

LAKE WATER QUALITY UPDATE 2013

Beaver Lake Water Quality Monitoring Program

From May through October during the recreational season, the City of Sammamish contracts with King County to work with volunteers to take lake water quality measurements through the recreational season. While the two largest inlet streams are flowing, the Beaver Lake Management District (BLMD) contracts with the King County Lakes Program to track their water quality late fall through spring.

Results

Although "water quality" can mean a number of different things, in summer several attributes are particularly important: water clarity, nutrients for algae, and chlorophyll. Changes in these over time may be associated with increased development and can foreshadow recurrent nuisance algae blooms or other problems.

In this article, we call the north lake basin Beaver-1 and the main south basin Beaver-2, similar to past articles.

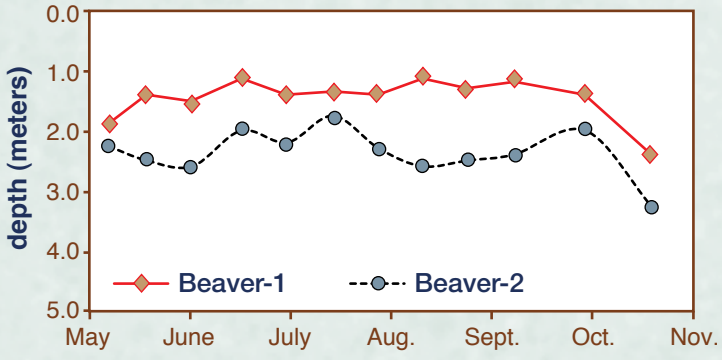
Secchi transparency measures water clarity. Reminder: water clarity charts are generally constructed with the Y-axis upside down, mimicking the depth at which a black-and-white Secchi disk disappears from view when lowered from the water surface.

Numerous small particles in the water interfere with water clarity, as well as water color from dissolved substances. While winter transparency is lessened by erosion from stormwater coming into the lake, decreased summer clarity is generally associated with algae populations. Changes in water clarity suddenly or over time often indicate something of interest happening in the lake.

In Beaver-1, water clarity was steady through season until mid-autumn, though its naturally amber-colored water made it consistently less clear than Beaver-2. Similar to 2012 and unlike 2011, there were no large blooms of cyanobacteria ("bluegreens") in late summer to decrease water clarity. Instead water clarity increased in October, likely due to seasonal change.

Beaver-2 water clarity was greater overall, as well as more variable than Beaver-1, but showed essentially the same pattern through the season. For both basins, clarity was similar to previous years when there were no large blooms in late summer.

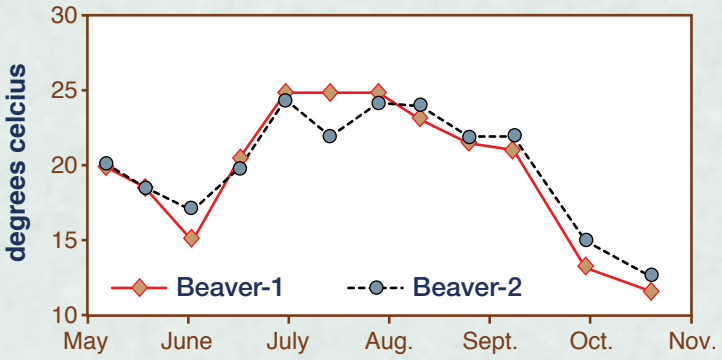
Secchi Water Transparency, 2013



Water temperature at shallow depths generally increases due to energy from the sun, air temperature, and mixing by wind. Water becomes less dense as it warms, which also affects the temperature distribution in lakes. Deep water will tend to remain cool through summer because of its higher density. Smaller lakes are especially sensitive to seasonal changes and often begin warming by March or April and then cooling in September. However, small lakes may also receive a great deal of water through ground flow in addition to over land flow. Such lakes will have cool deep water throughout the summer. Ground water flow may be known as "springs" by local residents and can cause those subsurface patches of cold water felt by swimmers, which have been reported in both Beaver-1 and Beaver-2.

Shallow water temperatures in both basins followed a similar pattern over the summer of 2013. Warm temperatures in May cooled in June and then shot up to seasonal highs of 25 degC in July. In August, the lakes cooled off slowly in tandem, but Beaver-1 was slightly cooler in temperature than Beaver-2.

Water Temperature at 1 Meter, 2013



Nutrients

Phosphorus is a naturally occurring element that is necessary in small amounts for life. Daily human activities and land development can increase concentrations in lakes, leading to more frequent and dense algae blooms that are unsightly and discourage recreational use, as well as a potential health threat to people and pets if toxin-producing species dominate the plankton..

Nitrogen is also necessary, and lack of available nitrogen can sometimes curb algae growth, but it is more abundant and less likely to limit algae than phosphorus. The ratio between the two nutrients (N:P) can determine which algal species have an advantage in plankton dominance. A sustained N:P

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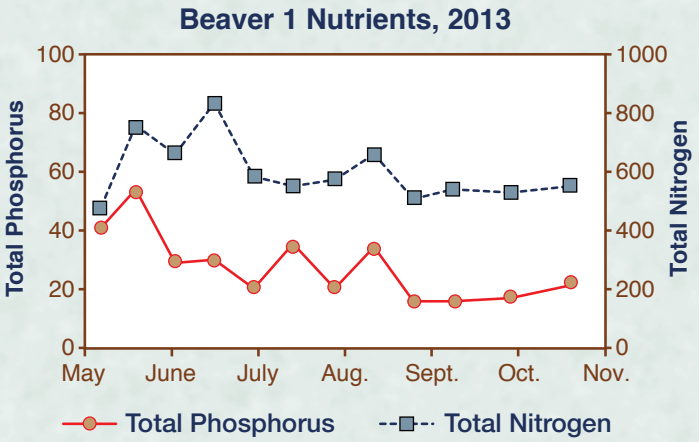
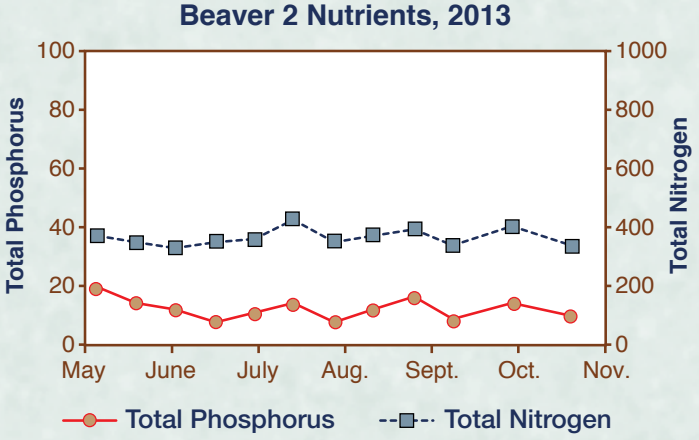
ratio below 20-25 signals a lake close to nitrogen limitation, perhaps in addition to phosphorus, and this may favor cyanobacteria that can use nitrogen from the air instead of relying on nitrogen coming into the lake from water inputs.

In Beaver-1, the amounts of total phosphorus and total nitrogen were higher early in the season than later. The minimum N/P ratio was 11.7 in early May, while the maximum was 34.5 in September, with an average of 24.4 over the period, very similar to 2012. The ratio was less than 25 for 42% of the measurements. Although bluegreens were present, there was no recurrence of the large bloom that troubled residents and users in 2011.

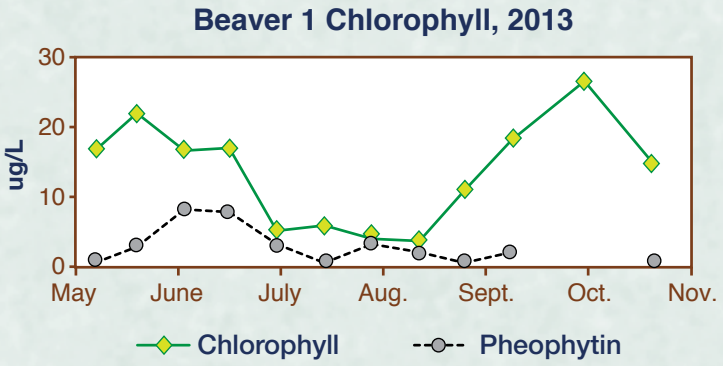


Over time, nutrients have generally occurred in lower concentrations in Beaver-2 than in Beaver-1, and 2013 followed the same pattern. For Beaver-2, phosphorus and total nitrogen concentrations remained steady throughout the season, with little change over the period, similar to recent years. The minimum N:P ratio was 18.8 at the beginning of monitoring, and the maximum was 44.8 in late July, while the average was 31.5. The lower N:P ratios occurred mostly in the spring and were below 25 for 25% of the samples measured. No bluegreen blooms occurred in the lake in 2013 during the period of measurement.

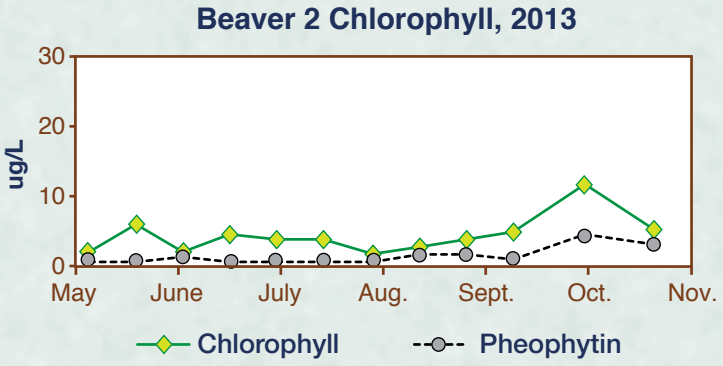


Chlorophyll is a measure of the abundance of the algae population present, as all algae must have some chlorophyll in order to carry out photosynthesis, the process that converts nutrients and sunlight into energy. However, cyanobacteria (bluegreen algae) also can have other pigments that capture light for photosynthesis, which means that chlorophyll measurements can sometimes under-represent the amount of cyanobacteria present.

Chlorophyll in Beaver-1 was higher in spring than in summer, then began climbing in late August to a maximum in October. The presence of significant Pheophytin in late spring suggests that the sample had significant amounts of degraded material in addition to rapidly growing algae. This could have been caused by senescence of the phytoplankton, soil disturbance around the side of the lake, or bottom disturbance of some kind.



Beaver-2 remained generally steady at moderate levels throughout the season, until late summer, when it made a maximum at the same time as Beaver-1, although it was three times lower in concentration.



Trophic state indicators (TSI) are values calculated from nutrient, Secchi transparency and chlorophyll measurements that can be used to predict algal productivity. TSI values allow for classification of a water body into 3 different levels of production, based on the results: high (eutrophic), medium (mesotrophic) and low (oligotrophic). The threshold between

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oligotrophic and mesotrophic is a value of 40, while the threshold between mesotrophic and eutrophic is 50.

While lakes can naturally fall into any of these classifications, increases in watershed development and human activities can nudge a a lake from a lower classification to a higher one. This usually happens due to increases in nutrients entering the lake, thus stimulating algae growth that increases chlorophyll and decreases water transparency. Thus all three TSI indicators reflect changes in algae populations. Tracking TSI values over time can produce a great deal of information about trends in water quality in a lake. The following discussion concerns average indicator values for both lakes during the period from May through October every year.

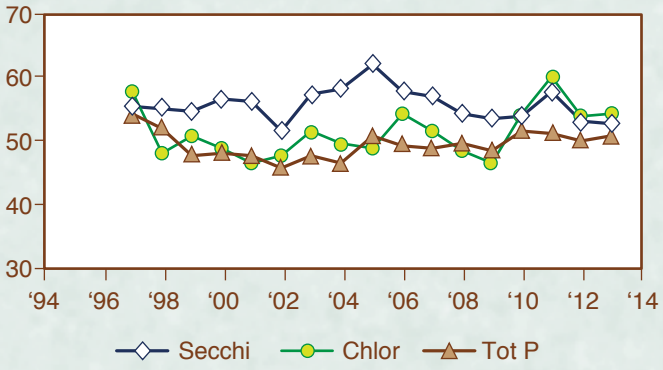
For the discussion below, a measurement called a correlation coefficient (r2) is used to illustrate the strength of a "fit" between time and change in water quality. This can vary from 0 to 1, with the higher the value, the better the relationship.

May – October TSI values have been calculated for Beaver-1 since 1997. Phosphorus and chlorophyll values have remained fairly close together over time, but appear to have diverged since 2010, with TSI chlorophyll higher than TSI total phosphorus. Varying around the threshold between mesotrophic and eutrophic conditions (a value of 50), phosphorus has an upward trend since 1999 with a moderate correlation (r2 = 0.569). TSI chlorophyll also shows an upward trend, but has a much weaker correlation (r2 = 0.328) and more variability over time.

This suggests that the amount of phosphorus and algae in Beaver-1 have been growing over the last decade, and this should be watched carefully, as it could relate to conditions in the high-quality sphagnum bog to the north which is the main source of surface water to the lake.

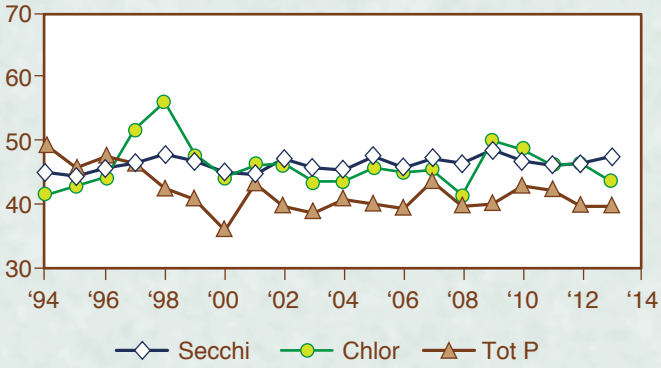
The Secchi TSI was significantly higher than the other two indicators in the past due to water color, but has tracked chlorophyll fairly closely in the last four years. This suggests that while water color has a large effect on water clarity in many years, algae has had a big effect recently. These values will bear watching, as it suggests that algae may be becoming more prominent in the lake.

Beaver-1 Trophic State Indicators



May – October TSI values have been calculated for the Beaver-2 basin since 1994. The years 1997-1998 had higher chlorophyll values than later years, with the sole exception of 2009, when an Anabaena bloom pushed the chlorophyll TSI value to the eutrophic threshold. In 2013, the TSI for phosphorus remained at the threshold between mesotrophy and oligotrophy. In Beaver-2, chlorophyll and phosphorus values do not seem to vary together as consistently as in Beaver-1, with no discernable trend. However, the TSI for Secchi relates well to TSI chlorophyll, showing that the algae present have a significant impact on water clarity in this basin. Currently, the lake is mid mesotrophic, remaining stable over time. This suggests that controls on stormwater in the basin have been successful to-date in preserving water quality in the main basin of the lake.

Beaver-2 Trophic State Indicators



Summary

Water quality parameters in Beaver Lake have remained generally stable for both basins since monitoring began in the 1990s. Occasional algae blooms continue to occur, but so far have been fairly rare and limited in extent.

The data suggest that current city land use controls and practices have been effective in keeping development from degrading the lake and its beneficial uses. However, there is an increasing trend in phosphorus content of the water in Beaver-1 that should be watched carefully and if it continues, conditions should be evaluated in the large high-quality wetland just north of the lake that supplies much of surface inflow to the north basin.

Living with Your Wildlife Neighbors – Frogs!

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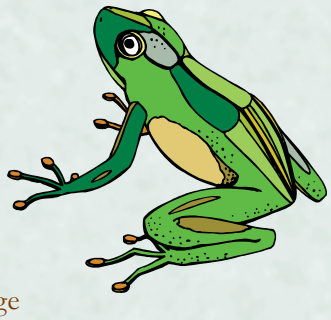

Their decline is attributed largely to declining habitat, exotic fish predation, and likely predation and competition from American Bullfrogs.

American Bullfrogs are common throughout the United States and have been observed in the Beaver Lake watershed. Bullfrogs are not native to the Pacific Northwest and were introduced for food and farming purposes during the Great Depression. Bullfrogs are the largest of the American frogs and can grow up to 8" long. They are olive green with a pale belly, and a disk-shaped eardrum on the side of the head. They were named for the "bar-room" mating call of the males. These frogs have been highly damaging to local ecosystems as they will eat just about anything, including other frogs, turtles, fish, and even ducklings. They will prey on native frog species; while at the same time they out-compete them for other food. Bullfrogs are more tolerant of muddy, polluted and warmer waters and habitats than most local frog species. In addition, bullfrog tadpoles are unpalatable to fish, decreasing the threat of predation.

American Bullfrogs are classified as a prohibited aquatic animal species in Washington State. It is against the law to transport or release bullfrogs, tadpoles, or their eggs. No license is required to hunt bullfrogs, and they can be managed by angling, spearing, or dip netting. Special care must be taken when collecting eggs or tadpoles as they can closely resemble those of native frog species. In addition, if you attempt to track down bullfrogs and their offspring, make sure not to disturb any native species in the area.

The easiest way to encourage frogs to live on your property is to create and preserve habitat that frogs find favorable. Construct areas of shelter by leaving rocks, woody debris, and leaf litter under shrubs and trees. Protect natural habitats buffering lakes, streams and ponds - areas where frogs live, hunt, and breed. You could even construct a small, fish-free pond lined with native plants to provide a frog breeding area. Avoid using pesticides and herbicides, as frogs' permeable skins are very sensitive to chemicals. For the same reasons, do not pick up or handle frogs. Not only could chemicals from your hands damage them, but the warm temperature could cause their skin to lose too much moisture.

Finally, allow frogs to come to you, do not try to relocate frogs to a new habitat. If your property has suitable frog housing, it is likely they will come on their own.

Resources:

Link, Russell. Living with Wildlife. Seattle: University of Washington Press, 2004.

Washington Department of Fish and Wildlife. "Living with Wildlife". 12 November 2013. http://wdfw.wa.gov/living/frogs.html

Washington Herp Atlas, 2009. Washington Natural Heritage Program, Washington Dept. of Fish & Wildlife, U.S.D.I. Bureau of Land Management and US Forest Service. www1.dnr.wa.gov/nhp/refdesk/herp/index.html

Fecal Coliform *(continued from page 3)*

and birds. Human waste can also provide FC inputs from such sources as leaking septic systems, illegal or cross connected sewage lines to storm drains, or contaminated sediments mobilized by construction or other disturbance.

E-coli bacteria move freely in water, and this can result in values that vary greatly between stations and over time. For this reason repeated sampling of locations is necessary to look for patterns in order to pinpoint problem areas. Since 2005, a total of 55 locations that have been sampled, either throughout the period of measurement or at shorter intervals in three Beaver Lake basins (Beaver- 1, Beaver- 2 and Beaver -3, also known as Long Lake). Sample locations have been added or dropped based on the results of previous samples. Those locations with higher values were sampled for longer periods, while those with consistently low values were replaced with other sites.

Of all locations sampled since 2005, no location has a geomean above the 50cfu/100mls standard. However, samples over the entire period from 7 sites exceeded the 10% of the samples exceeding 100 cfu/100mls guideline. Most of those locations have had just one or two samples exceed the 100 cfu/100mls threshold, and 2 locations were sampled less than 10 times. One location with several high values was near an active construction project, and it was suspected that contaminated soils had been disturbed. The contractors were alerted, action taken, and no further high vales were noted at that site.

The site with the highest geomean (27.27cfu/100mls) was at the outlet from Beaver- 3 that flows into Laughing Jacobs Creek. Three of the 11 samples

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January 2014

Fecal Coliform *(continued from page 7)*

were above the guideline. Many waterfowl frequent the area, and they may be responsible for the elevated levels.

The year 2013 was the first in which no single sample exceeded the state standard (see data table). All sites sampled had at least 1 sample with no bacteria detected, and no sample exceeded the 100 cfu/100mls standard.

Given the consistently low values found over time, future summer testing is under evaluation by the Beaver Lake Management District Board. Although routine sampling may end with the 2013 effort, spot testing may be a future option if new concerns arise about bacterial contamination or significant soil disturbance in a sensitive area of the watershed.

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The Beaver Lake Monitor

The Beaver Lake Monitor is published by the Beaver Lake Management District Advisory Board with the assistance of King County Water and Land Resources Division.

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